Two Systems for Handling Beef Subprimals From a Central Fabricating Facility to Retail Stores

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PREFACE

The research on which this publication is based is part of a broader program of research to reduce the costs of marketing agricultural products.

The author expresses his appreciation to the two supermarket firms who cooperated by supplying the necessary data and making their facilities available.

Upon request, single free copies of this publication may be obtained from the Market Operations Research Laboratory, Beltsville Agricultural Research Center, SEA, USDA, Beltsville, Md. 20705.

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By Charles L. Goulston 1/

ABSTRACT

Two systems for handling beef subprimals from a central fabricating facility to retail stores were studied, and their costs compared. The two systems consisted of subprimals encased in vacuum plastic bags which were placed in corrugated cartons or wire baskets mounted on dollies. The study began when the subprimals were placed in a vacuum plastic bag and ended when the bag was placed in the retail store cooler. The firm using corrugated cartons has a weekly output of 270,000 pounds of beef subprimals. The firm using wire baskets has a weekly output of 1 million pounds.

The costs considered were for labor, materials, and equipment. Labor costs included an allowance of 25 percent for fringe benefits. Equipment costs included depreciation, interest, insurance, taxes, maintenance and, in some cases, utilities. The higher total cost of $1.37 per cwt (hundredweight) of beef subprimals for the corrugated carton system over the $0.62 per cwt for the wire basket system could be reduced by increasing the number of uses per carton. However, it is doubtful that the total costs would approach the lower costs of the wire basket system. Additional advantages of wire baskets are also listed.

KEYWORDS: Beef, subprimals, transporting, fabricating.

INTRODUCTION

In 1975 Americans consumed 25,398 million pounds of beef, a recordbreaking 120 pounds per capita. 2/ These figures probably will continue to follow an increasing trend in future years, providing beef prices stay within affordable levels.

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2/ U.S. Department of Agriculture, Agricultural Statistics 1977, p. 357. Washington, D.C.

Many changes are being made in the beef production and marketing chain, most of which will bring about increased efficiencies, which in turn will help hold down beef prices during these inflationary times. One of the recent changes is that the beef arriving at retail stores has been prefabricated into primal or subprimal cuts either at the packing plant or at a central fabricating facility. These cuts are usually sealed into a vacuum plastic bag and shipped to the store in corrugated cartons or in some type of basket. Traditionally, the meat arrived at the retail store in carcass form, either cut in half or quartered.

Some benefits of prefabricating beef in this manner are the following:

° Cutting operations of beef can be more efficiently done at the packing plant or at a central facility than at the retail store because the beef cutters are more specialized and operations resemble an assembly line rather than a butcher shop.

° Transportation costs may be reduced because less fat and bone are shipped to the stores.

° Moisture loss is reduced when beef is stored in vacuum bags as opposed to beef exposed to the air.

° Sanitation is improved and shelf life is increased because fewer people handle the beef surfaces, thus impeding some types of bacterial growth in the vacuum plastic bag.

° Fat and bone are usually more valuable when removed at a central facility than at the retail store.

° Less floor space is required to store the meat at each retail store.

According to a 1975 survey, 3/ 68 percent of beef received by retail stores in the United States during 1974 was prefabricated primals or subprimals. This figure is expected to reach 79 percent by 1980. The 1975 survey included independent grocery stores as well as supermarket chain stores.

As the amount of prefabricated beef arriving in stores increases, more supermarket chains are building central facilities where beef is received in carcass form, fabricated into primal or subprimal cuts, packaged in a vacuum plastic bag or wrapped with plastic film, stored, and shipped to retail stores by truck. Affiliated independent stores often receive their beef in a similar manner.

This publication reports on a study of two systems and their costs for handling prefabricated beef subprimals from a central fabricating facility to retail stores. The two systems were the corrugated cartons and wire baskets.

3/ John W. Allen, A Look at Trends in the Meat Industry ... 1975. Supermarket Institute Convention Workshop, May 6, 1975.

PROCEDURE

The data in this report were obtained in 1976 from detailed studies of two central fabricating facilities operated by supermarket chains in the eastern United States. Beef was received in carcass form and cut into subprimal cuts and each cut was placed in a vacuum plastic bag. Once the beef cuts had been packaged, a conveyor carried the bags to the packing station where they were placed in either a corrugated carton or a wire basket.

The study began when the cuts were placed in vacuum plastic bags and ended when the bags were placed in the retail store cooler. A few peripheral operations and their costs are included for more realistic and meaningful results.

The two systems were analyzed in terms of labor, materials, and equipment requirements and costs incurred by the two firms. Labor costs were derived from stopwatch time studies. An adjustment of 15 percent was added to all operations to allow for personal needs of the operator, for fatigue, and for a limited amount of unavoidable delays.

Since the purpose of this study was to evaluate existing operations and systems, a certain amount of nonproductive time was included in the analysis. In some instances this nonproductive factor resulted from time study. When the measured nonproductive time seemed excessive, an estimated figure was used. This factor represents nonproductive time inherent in the operation. The only way nonproductive time could be eliminated would be by major changes in the plant layout or personnel assignments.

The adjusted man-hour requirements were converted to costs by using the prevailing 1976 average wage rate of $7.50 per hour, as reported by the cooperating firms. An average wage rate from both firms was used so that the rate would not affect the comparison. A factor of 25 percent was added to cover the cost of fringe benefits, making the effective labor rate $9.375 per hour.

Materials costs were obtained from the firms' records and converted to a cost per hundredweight of product handled.

The cost of floor space for each system was not considered for several reasons. One firm's output was about four times the other, so that the larger firm enjoyed certain economies of scale including economy of floor space per unit of output. Both systems had the capability of stacking loaded pallets (or dollies) in racks three tiers high, but only one firm used this method. Therefore, the costs of floor space and of pallet racks used by one firm were excluded.

Equipment costs were based on 1976 replacement costs and included equipment installation where applicable. These cost figures were obtained from either the cooperating firm or the manufacturer.

Annual ownership and operating costs included depreciation of the equipment, interest, insurance, taxes, maintenance, and utilities. Depreciation was calculated on a straight-line basis and was equal to equipment replacement cost divided by its useful life. Equipment was assumed to have no salvage value

at the end of its useful life. The figure for useful life was based on the firms' experience. In a few instances, however, manufacturers' estimates were used.

An interest rate of 9 percent covered either the cost of borrowing money or the cost of lost income when company funds were spent on equipment. This is equivalent to applying a factor of 4-1/2 percent to all equipment costs to represent the average annual interest on the undepreciated value of the equipment over its useful life.

Insurance and local taxes on the equipment varied widely depending on the geographic location of the firm. For this study, a 4-percent rate was used. Other insurance and local tax rates can be easily inserted to replace those contained in this report.

When available, maintenance costs were based on the firms' records. Otherwise, they were based on the firms' estimates.

Costs of utilities were considered only for battery charging of materials-handling equipment, such as forklift trucks and pallet transporters. Computations were based on the equipment manufacturers' specifications, on the firms' estimates of the number of hours the equipment is used annually, and on an assumed cost of $0.03 per kilowatt-hour. Because power consumption for other pieces of equipment was insignificant, the cost was not included.

In comparing the two systems there were obvious difficulties, because of the many differences existing between the two firms. To minimize these differences and make comparison more equitable between the two systems, some basic assumptions were made as explained in the following paragraphs.

To receive incoming product, one firm used electric pallet jacks at most of its retail stores. The other firm used manual pallet jacks exclusively. The decision to use manual or electric equipment in each store was based on economic factors and had little to do with the two systems. Consequently, in figuring labor costs, the writer assumed that both firms used electric pallet jacks. The cost of the stores' pallet jacks allocated to the beef subprimals was deemed insignificant due to the small percentage of their total use time for beef subprimals. Therefore, the pallet jack costs were not included.

No two retail stores were identical in layout, design, or size. Some stores had receiving docks; some had none. One store had an elevator to transfer merchandise from the receiving dock level to the main store level. Travel distances varied from store to store. Therefore, it was assumed that both firms' stores had loading docks and that travel distances within the stores were equal.

The amount of product transported per unit of trailer space was assumed identical for both systems. (The reason for this assumption is given in the "Discussion" section of this report.) It was also assumed that both firms' trucks traveled the same distances and hauled the same size trailers. With these assumptions, introducing transportation costs is unnecessary, as they would be identical for both systems. Loading and unloading of the trailer, however, are included.

One of the major difficulties was to isolate the costs of handling beef subprimals from those of such products as poultry, delicatessen items, and ground beef. Both firms handled other products and, in varying degrees, intermingled these products with the beef subprimals. Fortunately, because the degree of intermingling was small, the costs could be separated. Consequently, the costs contained herein apply only to beef subprimals. In determining equipment costs, however, it was sometimes necessary to allocate part of these costs to the subprimals while ignoring the remaining portion. This was particularly true for materials-handling equipment. The equipment cost tables explain the bases for these allocations.

DESCRIPTION OF SYSTEMS

The two firms (A and B) were chainstores that operated central beef fabricating facilities located in the eastern United States. These facilities served a particular geographical region. Both firms have similar facilities that serve other regions.

Firm A shipped vacuum bags of subprimals in corrugated cartons and Firm B shipped them in wire baskets. Firm A had a weekly output of about 270,000 pounds of beef subprimals, while Firm B had a weekly output of about 1 million pounds.

Firm A, Corrugated Cartons

At Firm A the vacuum plastic bags of subprimals conveyed to the packing station were placed in cartons. Three sizes of cartons were used: (1) the most common size, measuring 24 by 14-5/8 by 10 inches high, accounted for 77 percent of the cartons used, (2) the second size, measuring 22 by 15 by 8 inches high, accounted for 20 percent of the cartons used, and (3) the third size, measuring 17 by 11 by 8 inches high, accounted for only 3 percent of the cartons used. The first two were double-walled corrugated fiberboard; the third was single walled. All were of 275# minimum bursting strength.

The operator usually made up his own cartons. He usually filled four or five different cartons simultaneously, each with a different subprimal cut. Upon completion, the operator pushed the filled cartons onto another conveyor for transporting to an in-line scale. There an operator recorded the weight on the carton, stamped the date, checked that the carton was correctly labeled, and fed the carton into the strapping machine. The carton was automatically strapped in two places and then ejected onto another conveyor. An operator removed the carton from the conveyor and, after deciding on which of four or five pallets to place the carton, stacked it on the proper pallet. The operator carried the cartons about 8 feet to the pallets.

A forklift operator secured the full pallet and transported the pallet load 30 feet to a platform scale for weighing. The operator recorded the weight on a form and on a tag and attached the tag to the pallet. He then transported the pallet load an average of 120 feet to the pallet rack where the load was positioned on one of three tiers.

Several support operations were included in this study. They were replenishing supplies of empty cartons, receiving pallet loads of empty cartons, receiving spools of strapping material, refilling strapping machine with strapping material, replenishing supply of empty pallets, and positioning empty pallets to be filled.

In the order assembly and shipping steps, an operator, using an electric pallet jack, rode up and down the aisles of pallet racks, selected the cartons for filling his order, and stacked them on his pallet jack. A forklift operator whose job is to keep the floor slots filled with product had previously lowered pallets of cartons from the upper tiers. When the selector filled a pallet, he traveled about 110 feet to a trailer positioned at the shipping dock and loaded the pallet into the trailer. Support operations include replenishing the supply of empty pallets and rotating the product in the pallet racks permitting the oldest product to be used first.

When the shipment arrived at the retail store, an operator with an electric pallet jack unloaded the pallets one at a time and transported them 90 feet to the cooler. He then returned to the trailer for the next pallet load. Occasionally he had to move aside empty pallets and knocked-down cartons that had been picked up at previous stops.

A few related operations that took place in the store are explained here. After removing the beef from the carton, an employee broke down the carton. If the cartons were not reusable, they were discarded. If reusable, the dismantled cartons were stacked with others to be returned to the central facility together with any empty pallets. Occasionally, a store returned all cartons. After a meat shipment had been delivered, the reusable cartons and empty pallets were loaded into the trailer.

When the cartons and pallets were returned to the central facility, an operator unloaded and transported them to the appropriate storage areas. All returned cartons were inspected. Any non-reusable cartons were discarded. The reusable ones were reworked by covering the old weight figures with a sticker and stacked for return to storage or the packing station.

The percentage of returned cartons fluctuated widely from store to store. Therefore it was assumed that two-thirds of all cartons were returned to the central facility. Since some cartons were discarded at the central facility, an average of 1.5 uses per carton was assumed.

Firm B, Wire Baskets

At Firm B the vacuum bags of subprimals conveyed to the packing station were placed in wire baskets (fig. 1). The wire baskets measured 40-1/2 by 24 by 11 inches (usable height when stacked on top of each other), each weighing 31 pounds. The dollies measured 40-1/2 by 24 by 10-1/2 inches high, each weighing 70 pounds. A mobile unit, measuring 74 inches high, consisted of six baskets stacked on one dolly.

Figure 1.--Placing subprimal in a wire basket.

The baskets had been previously stacked six high on a four-wheeled dolly. When the operator filled all six baskets on a dolly, he pushed aside the dolly and moved in an empty one. Usually an operator filled two or three dollies at a time, each with a different subprimal cut.

An operator picked up the full dolly load with an electric pallet jack and transported the load about 100 feet to a platform scale. Here another operator observed and recorded the weight of the dolly. The pallet jack operator again picked up the dolly and transported the load about 220 feet to the meat holding cooler (fig. 2). He placed the dolly in its proper location and returned to the fabricating line for another dolly load. Occasionally, two dollies were transported at the same time (fig. 3).

In filling orders for shipment to the retail stores, the order selector picked up a store's order sheet. Using an electric pallet jack, the selector traveled about 100 feet to the meat holding cooler. At the aisle containing the specified subprimal cuts, he lifted the required number of baskets onto an empty dolly which was on his pallet jack. A specially equipped chain hoist was used for this purpose (fig. 4). He then traveled to the location of the next specified subprimal cuts and lifted the required number of baskets. When two dollies were loaded with five or six baskets on each, he tied the two dollies together with twine and labeled them with the identifying store number. He then transported the dollies to either a holding area or the loading dock--a distance of 200 to 300 feet. He then returned to the holding cooler for another order selection.

Figure 2.--A view of the meat holding cooler.

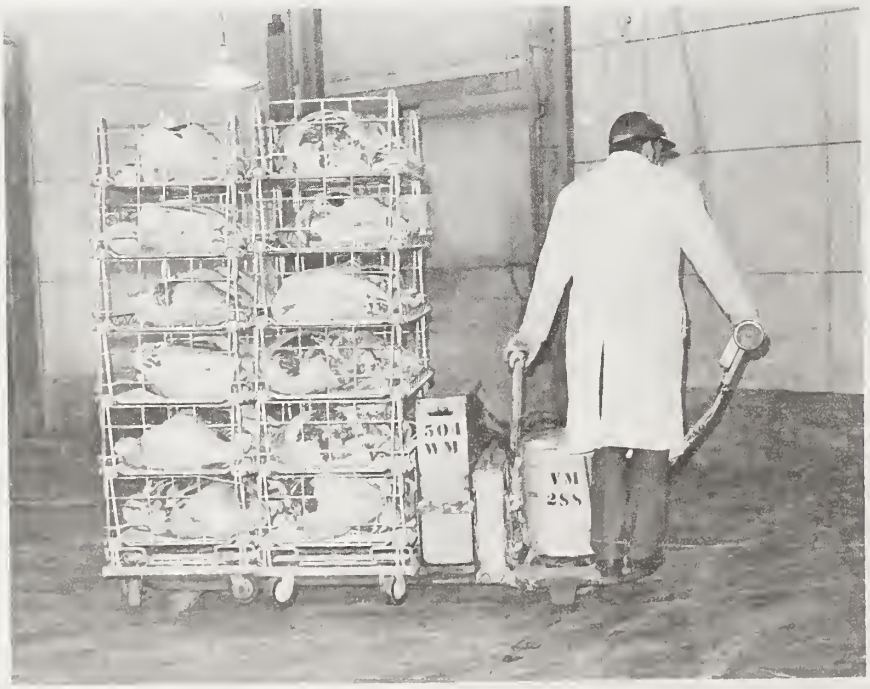

Figure 3.--Transporting full dollies to the meat holding cooler.

Figure 4.--Assembling an order using a chain hoist.

At the time of loading, an electric pallet jack operator picked up the two-dolly unit and loaded the unit into a trailer. About every eight dollies a strap was positioned in the trailer to secure the load. The one-way travel distance for the loading operation varied from 50 to 150 feet.

At the retail store, an operator unloaded the dollies, which were tied together in pairs, one pair at a time, and transported them 90 feet to the meat cooler with an electric pallet jack. He then returned to the trailer for the next pair of dollies. Occasionally he moved aside empty baskets and dollies that had been picked up at previous stops. Empty baskets and dollies were nested together and transported manually from the cooler to the shipping dock. (This was usually done on a regular basis as baskets were emptied.) The pallet jack operator loaded the empty wire baskets and dollies into the trailer and fastened them to prevent their movement during transit to the central facility.

At the central facility (fig. 5), the returned baskets and dollies were unloaded and transported by electric pallet jack to the wash holding area--a distance of 150 to 250 feet. After a brief inspection, the baskets and dollies were moved about 110 feet into the washroom, using a special electric pallet jack with extended forks.

The washing procedure consisted of soaping all dollies and baskets using a sudsing machine with hose attached (fig. 6). While the baskets were still nested together, the operator rinsed them with hot water. Another operator then

Figure 5.--Empty baskets and dollies being returned to the central facility.

Figure 6.--Soaping down dollies and baskets.

moved the cleaned baskets and dollies from the washroom into the fabricating holding area by using an electric pallet jack with extended forks. The distance is 315 feet.

At the fabricating holding area, the baskets were stacked six high on dollies. An electric pallet jack then transported these stacked baskets and dollies to the end of the fabricating line--a distance of 75 feet.

RESULTS

Firm A, Corrugated Cartons

Table 1 lists the labor costs, man-minutes per cwt, and the dollars per cwt for each operation. The total labor cost for Firm A is $0.511 per cwt.

Table 2 lists the equipment requirements and costs for Firm A's operation. The total annual ownership and operating cost is $25,156, which amounts to $484 per week. Based on an average weekly output of 270,000 pounds, the equipment cost for Firm A is $0.179 per cwt of output.

Appendix A describes how the costs for cartons and strappings were determined. Those costs are $0.661 per cwt and $0.021 per cwt, respectively. Table 3 summarizes all of the costs for Firm A.

Firm B, Wire Baskets

Table 4 lists the labor costs per cwt for each operation. Also shown are the man-minutes per cwt. The total cost of labor for Firm B is $0.405 per cwt.

Table 5 lists the equipment requirements and costs for Firm B's operation. The total annual ownership and operating cost is $104,973, which amounts to $2,019 per week. Since the firm's average weekly output is 1 million pounds, the cost of equipment per cwt of output is $0.202.

The only other cost for Firm B was for soap and water, which is used for washing the baskets and dollies. After studying company records, it was determined that these cost approximately $0.015 per cwt. This item was included since it was a specific cost which was unique to Firm B's operation. All costs for Firm B are summarized in table 6.

Costs for shipping subprimal cuts of beef in corrugated cartons from the central processing facility to the stores (table 3) were approximately $1.37 per cwt of product as compared with approximately $0.62 per cwt using wire baskets (table 6).

DISCUSSION

Before a reader can decide whether cartons or wire baskets and dollies will better meet his needs, he should consider the factors presented below.

Table 1.--Labor costs for Firm A 1/

Operation number	Operation	Man-minutes per cwt 2/	Cost per cwt 3/
			Dollars
A-1----------	Make up carton, load wrapped subprimal into carton	0.66	0.103
A-2----------	Position new stack of cartons, replenish stacks	.06	.009
A-3----------	Weigh and mark carton, feed into strapping machine	.57	.089
A-4----------	Push cartons down conveyor, load onto pallet	.33	.052
A-5----------	Weigh and tag full pallet, place in rack	.23	.036
A-6----------	Unload empty cartons from truck, place in rack, remove from rack	.03	.005
A-7----------	Lower full pallets from upper slots to floor slots	.07	.011
A-8----------	Assemble store orders on pallets, load into trailer	.44	.069
A-9----------	Unload order from trailer, move to store cooler	.24	.037
A-10---------	Break down empty cartons, discard non-reusable ones, stack good ones	.28	.044
A-11---------	Stack empty pallets for return, load on trailer, unload	.07	.011
A-12---------	Unload returned cartons, inspect and rework reusable ones	.29	.045
Total----------		3.27	.511

1/ Refer to appendix B for more details.

2/ Includes 15 percent allowance for personal needs, fatigue, and unavoidable delays.

3/ Based on average hourly rate of $7.50 plus 25 percent for fringe benefits.

Table 2.--Equipment requirements and costs for Firm A

Type of equipment	Quantity	Unit cost	Total cost	Estimated life 1/	Annual depreciation 2/	Interest 3/	Insurance and taxes 4/	Total fixed costs 5/	Maintenance 6/	Power	Total costs 7/
		Dollars	Dollars	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Wooden pallet (40 x 48 inches)--------	1,500	6	9,000	3	3,000	405	360	3,765	1,845	--	5,610
Pan scale (125 lb cap)--------	1	1,750	1,750	10	175	79	70	324	200	--	524
Pallet scale (2,600 lb cap)-	1	8/6,400	6,400	10	640	288	256	1,184	400	(10/)	1,584
Conveyor (assorted types)---------	9	(9/)	23,500	8	2,938	1,058	940	4,936	1,175	(10/)	6,111
Strapping machine--------	1	10,500	10,500	10	1,050	472	420	1,942	500	(10/)	2,442
Forklift truck----------	1	14,800	14,800	10	1,480	666	592	2,738			
Battery (36 volt, 800 amp-hr)----	1	2,000	2,000	7	286	90	80	456	261	11/228	3,794
Battery charger--	1	600	600	10	60	27	24	111			
Electric pallet jack----------	5	3,200	16,000	10	1,600	720	640	2,960			
Battery (12 volt, 450 amp-hr)----	5	800	4,000	7	571	180	160	911	338	12/420	5,091
Battery charger--	5	500	2,500	10	250	112	100	462			
Total-------	--	--	91,050	--	--	--	--	--	--	--	25,156

1/ Based on manufacturer's or user's estimate.
2/ Straight-line depreciation, zero salvage value is assumed.
3/ 9 percent interest or average of 4-1/2 percent of initial cost per year.
4/ 4 percent of initial cost per year.
5/ Total of depreciation, interest, insurance, and taxes.
6/ Based on user's records or estimate.
7/ Total of fixed costs, maintenance, and power.
8/ Includes $2,000 for installation.
9/ Unit costs not shown because of variety of conveyors.
10/ Power used is negligible and not considered here.
11/ Based on 2,000 hours of use annually.
12/ Based on 10,000 equipment-hours of use annually.

Table 3.--Summary of costs for Firm A

Cost category	Cost per cwt
	Dollars
Labor (from table 1)	0.511
Equipment (from table 2)	.179
Cartons (from appendix A)	.661
Strapping (from appendix A)	.021
Total	1.372

The cost of cartons accounted for about 48 percent of the total cost for Firm A (see table 3). This cost was based on the assumption that each carton was used an average of 1.5 times. There was a wide variation in the percentage of cartons which each store returned. With proper managerial policy and control, an average of two uses per carton possibly could be attained, resulting in a significant cost reduction. The average uses per carton will also depend on handling of the cartons, exposure to moisture, stacking heights, Federal and local health regulations, and the effectiveness of store supervision.

Wire baskets and dollies accounted for about 89 percent of the total annual equipment costs for Firm B (see table 5). This was based on the estimated quantity of baskets and dollies required for this operation rather than the quantity actually purchased, which was somewhat greater.

To decide how many wire baskets and dollies should be purchased for a specific operation several factors must be taken into account. These factors include initial equipment cost, daily production rates, amount of meat normally contained on each shelf, meat holding time in central facility and retail stores, frequency of deliveries to stores, number of stores serviced, and the possible diversion of this equipment to other functions.

After several years' experience with wire baskets, Firm B realized that many baskets had been diverted from the beef subprimal operation to other uses, mostly by retail store personnel. These uses included display of produce, eggs, dairy products, and house plants, and substitutes for pallets and stepladders. Close control of the wire baskets should be maintained or provisions should be made for purchasing sufficient baskets to offset those which might be diverted to other uses.

In order to use the particular wire baskets purchased by Firm B, and stack them six high, the door openings of all store meat coolers must have a minimum height clearance of 6 feet, 8 inches. If the openings are much less, the baskets can only be stacked five high, or the sixth basket must be removed before placing the meat in the cooler.

The order assembly operation (table 4, B-4) accounted for about 32 percent of the total labor cost for Firm B. This was due mainly to the ceiling-mounted

Table 4.--Labor costs for Firm B 1/

Operation number	Operation	Man-minutes per cwt 2/	Cost per cwt 3/
			Dollars
B-1	Load wrapped subprimals in baskets	0.29	0.045
B-2	Transport full dolly to scale, then to meat holding cooler	.31	.049
B-3	Weigh full dolly, record weight, tag dolly	.09	.014
B-4	Assemble order, label order, transport to holding area	.82	.128
B-5	Move order from holding area into trailer	.12	.019
B-6	Unload order from trailer, transport to store cooler	.22	.034
B-7	Stack empty baskets and dollies for return	.08	.013
B-8	Load empty baskets and dollies on trailer at store	.20	.031
B-9	Unload empty baskets and dollies, move to wash holding area	.07	.011
B-10	Transport empty baskets and dollies from wash holding area to washroom	.06	.009
B-11	Wash empty baskets and dollies	.10	.016
B-12	Transport clean baskets and dollies to fabricating hold area	.08	.013
B-13	Restack 6 clean baskets on a dolly	.09	.014
B-14	Transport restacked baskets from hold area to fabricating line	.06	.009
Total		2.59	.405

1/ Refer to appendix C for more details.

2/ Includes 15 percent allowance for personal needs, fatigue, and unavoidable delays.

3/ Based on average hourly rate of $7.50 plus 25 percent for fringe benefits.

Table 5.--Equipment requirements and costs for Firm B

Type of equipment	Quantity	Unit cost	Total cost	Estimated life 1/	Annual depreciation 2/	Interest 3/	Insurance and taxes 4/	Total fixed costs 5/	Maintenance 6/	Power	Total costs 7/
		Dollars	Dollars	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Wire basket-----	8/18,000	16	288,000	10	28,800	12,960	11,520	53,280	3,000	--	56,280
Dolly-----------	8/ 3,000	58	174,000	8	21,750	7,830	6,960	36,540	1,000	--	37,540
Electric chain hoist---	4	800	3,200	5	640	144	128	912	500	(9/)	1,412
Detergent pump and hose------	1	1,000	1,000	8	125	45	40	210	50	(9/)	260
Platform scale, pit type (5,000 lb cap)-------	1	10/7,700	7,700	10	770	346	308	1,424	1,200	(9/)	2,624
Electric pallet jack----------	4	3,000	12,000	8	1,500	540	480	2,520			
Battery (12 volt, 540 amp-hr)---	11/8	550	4,400	7	629	198	176	1,003	282	12/756	5,005
Battery charger circuit-------	4	600	2,400	10	240	108	96	444			
Electric pallet transporter 13/	1	3,500	3,500	10	350	158	140	648			
Battery (12 volt, 540 amp-hr)---	1	550	550	7	79	25	22	126	70	14/ 63	1,018
Battery charger circuit-------	1	600	600	10	60	27	24	111			
Electric pallet jack 15/------	2	1,000	2,000	8	250	90	80	420			
Battery (12 volt, 540 amp-hr)15/	11/4	183	732	7	105	33	29	167	47	16/126	834
Battery charger circuit 15/---	2	200	400	10	40	18	16	74			
Total------	--	--	500,482	--	--	--	--	--	--	--	104,973

1/ Based on user's estimate.
2/ Straight-line depreciation, zero salvage value is assumed.
3/ 9 percent interest or average of 4-1/2 percent of initial cost per year.
4/ 4 percent of initial cost per year.
5/ Total of depreciation, interest, insurance, and taxes.
6/ Based on user's records or estimate.
7/ Total of fixed costs, maintenance, and power.
8/ This is an estimate of the quantity required rather than the quantity actually purchased. See "Discussion" section for further explanations.
9/ Power used is negligible and not considered here.
10/ Includes $1,600 for installation.
11/ There are 2 batteries for each jack to enable continual use of jack.
12/ Based on 18,000 equipment-hours annually.
13/ Equipped with extended forks.
14/ Based on 1,500 hours of use annually.
15/ This equipment is used for only 1 shift for the subprimals and 2 shifts elsewhere. Therefore, all costs shown are 1/3 of total costs for this equipment with exception of power costs (see footnote 16).
16/ Based on 3,000 equipment-hours annually for subprimals only.

Table 6.--Summary of costs for Firm B

Cost category	Cost per cwt
	Dollars
Labor (from table 4)	0.405
Equipment (from table 5)	.202
Soap and water	.015
Total	.622

electric chain hoists which were used to pick the required number of baskets from a dolly and lower them onto another dolly. During the study a similar operation was observed where the use of an electric walkie stacker (or lift truck) was considerably faster than the electric chain hoists. The particular method employed to assemble store orders can significantly affect the labor costs of the wire basket system.

Based on Firm B's actual experience, the maintenance cost for the platform scale was $1,200 per year (table 5). The scale must be overhauled each year because of its location in a cold, damp environment and its subjection to daily washings. If this scale were replaced with an electronic scale, maintenance costs could be greatly reduced.

Table 1 indicates that there are two operations in which meat is weighed at Firm A. First, each filled carton is weighed; then each full pallet is weighed. Elimination of the pallet weighing would result in a small cost savings.

One of the assumptions in this report is that the amount of product transported per unit of truck space is identical for both systems. Actually an average pallet in Firm A contained 1,494 pounds of product; two dollies in Firm B contained 1,656 pounds of product. Firm A's pallet used the same amount of truck space as two of Firm B's dollies. Both systems had a potential for increasing the amount of subprimals on a pallet or a dolly. Furthermore, trailers were rarely filled to capacity. Therefore, it was decided not to penalize either system based on the amount of product per unit of trailer space.

In addition to a significant cost savings, other advantages in using wire baskets and dollies, particularly at the retail store, are:

- Rotation of subprimals in the store cooler is much easier.
- Filled baskets can be wheeled from the cooler to the cutting room thus eliminating the need to hand-carry smaller amounts of subprimals.
- The likelihood of crushed subprimals and leaky plastic bags is greatly reduced.
- Leaky bags, when they do occur, are easier to detect.
- There is better circulation of cold air around the subprimals.

- Unloading the meat from the trailer at the stores is easier since the wire baskets don't shift in transit as cartons do.

CONCLUSIONS

Of the two systems studied, the one using wire baskets and dollies was considerably less costly than the one using corrugated cartons. The costs of the carton system could be reduced by more uses per carton, but not enough, in the author's opinion, to approach the cost of the wire basket system. Also, there is potential in reducing the costs of the wire basket system further by improving the order assembly operation. Furthermore, wire baskets have several other advantages, including easier rotation of meat in the store's cooler, easier handling of meat in the store, less crushing and leaking of vacuum plastic bags, and better air circulation around the bags.

APPENDIX A--NOTES ON SECONDARY COSTS

The cost items included in this study are labor, equipment, and materials. The procedures used in arriving at these costs were explained in the section entitled "Procedure." Some additional explanation may be useful regarding determining certain figures used as the basis for other cost figures.

Firm A

Average pieces per carton.--This figure was used in calculating the labor requirements for operation A-1. For each type of subprimal cut, the number of pieces placed in a carton was determined. The numbers, ranging from 1 to 6, were weighted by the number of boxes of each subprimal shipped in a year. The weighted average pieces per carton was 2.3.

Average weight per carton.--This figure was used in converting labor times in terms of "per carton" to "per cwt." For each type of subprimal cut, the average carton weight was determined. These figures, ranging from 29 to 76 pounds, were weighted by the number of boxes of each subprimal shipped in a year. The weighted average weight per carton was 59 pounds.

Average weight per pallet load.--This figure was used in converting labor times for a few operations measured in terms of "per pallet load" to "per cwt." For each subprimal cut, the average net pallet weight was determined. These figures, ranging from 1,102 to 1,525 pounds, were weighted by the number of pallets of each subprimal shipped in a year. The weighted average net weight per pallet was 1,494 pounds.

Cost of cartons.--This cost represents the largest single contributor to the total cost of Firm A's operation. The three types of cartons had unit costs of 60, 59, and 29-1/2 cents. The average capacity of these three cartons was calculated as 59.9, 61.0, and 30.6 pounds, respectively. Based on these two sets of figures and also on the frequency of each carton's use, the weighted cost of cartons per cwt of product was $0.992. However, assuming that each carton was used 1.5 times, the effective cost of cartons was $0.992 divided by 1.5 or $0.661 per cwt.

Cost of strapping.--Two lengths of strapping were used to seal each carton. A 20,000-foot coil of strapping sufficiently sealed 2,500 cartons. Since a coil cost $31.40, this amounted to $0.0126 per carton. Based on an average weight of 59 pounds per carton, the cost of strapping was $0.0126 divided by 59 or $0.021 per cwt.

Average pieces per basket.--This figure was used in determining the labor requirements for operation B-1. For each type of subprimal cut, the number of pieces placed in a basket was determined. The numbers, ranging from 3 to 15, were weighted by a frequency distribution based on the number of baskets of each type of subprimal shipped in a year. The weighted average pieces per basket was 4.3.

Average weight per basket.--This figure was used in converting those operations whose labor times were measured in terms of "per basket" to "per cwt." For each type of subprimal cut, the average weight of a full basket was determined. These weights, ranging from 95 to 156 pounds, were weighted by the same frequency distribution used for "average pieces per basket." The weighted average weight per basket was 138 pounds.

Average weight per full dolly.--This figure was used in converting labor times for a few operations measured in terms of "per full dolly" to "per cwt." Since a full dolly consisted of six full baskets, the average weight per full dolly was calculated by multiplying 138 pounds, the average weight per basket, by 6. The average weight per full dolly was 828 pounds.

Average weight per pallet-equivalent.--This figure was used in converting labor times which were measured in terms of "per pallet-equivalent" to "per cwt." A pallet-equivalent is defined as two full dollies and, therefore, consists of 12 full baskets. Since a full dolly has an average weight of 828 pounds, then a pallet-equivalent has twice that weight, or 1,656 pounds.

APPENDIX B--NOTES ON TABLE 1

The following notes refer to specific operations listed in table 1:

A-1 The time shown includes a factor of 16.7 percent for nonproductive time which is inherent in this operation.

A-3 The time shown includes a factor of 16.7 percent for nonproductive time. It also includes time for installing a new spool of strapping as required.

A-4 This operation includes a forklift operator positioning empty pallets after a full one has been removed.

A-6 This operation includes removing pallets of empty cartons from the racks and lowering them to the ground for operation A-2 as required.

A-7 This operation is in support of operation A-8. It includes occasional manual shifting of cartons from one pallet to another.

APPENDIX C--NOTES ON TABLE 4

The following notes refer to specific operations listed in table 4:

B-1 The time shown includes a factor of 20 percent for nonproductive time, which is inherent in this operation. Also included is time to inspect each bag for leaks.

B-2 The time shown includes a factor of 10 percent for nonproductive time, which is inherent in this operation. It also includes the operator's waiting time while another operator weighs the dolly (operation B-3).

B-3 The time shown includes a factor of 10 percent for nonproductive time. It also includes time for maintaining certain production records.

B-5 This operation includes securing the load in the trailer with a strap, which is usually done once for every eight dollies.

B-8 This operation includes moving the baskets and dollies from the store cooler to the loading dock and strapping them in the trailer to prevent their shifting during transit.

B-10 This operation includes occasional restacking of the baskets and dollies, and removing any trash that may be attached to them.

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